

Priority Pollutant (PP) test data

Background. Priority Pollutant tests are chemical analyses for specific compounds that may have toxic effects to aquatic organisms or humans. EPA has provided guidance for acceptable water quality criteria for many toxic compounds. The criteria as of August 13, 1997 are incorporated by reference in the toxics rule as State standards. Where EPA has not provided guidance for water quality criteria for a compound known to have toxic effects, the Department will use the best available scientific information to set safe levels on a case by cases basis. When the in-stream concentration of a pollutant is calculated to be greater than the water quality criteria after considering dilution of an effluent in the receiving water, an exceedence is recorded. Some toxic compounds have water quality criteria for protection of aquatic organisms and are evaluated on the basis of acute and chronic levels. In fresh water discharge situations where the effluent is initially not well mixed with the receiving water, the acute impact is based on the $\frac{1}{4}Q_{10}$ flow. Additionally, human health impacts are evaluated on a longer term basis using the harmonic mean flows or, in the case of marine discharge situations, a comparable value of three times the chronic dilution. The human health criteria consist of separate values for only consumption of organisms taken from the receiving water and consumption of both water and organisms. Both of these criteria are applied to fresh water discharges, while the organisms only criterion is used for marine discharges. The water quality criteria for several metals in fresh water are dependent on the hardness of the receiving water, with a greater hardness diminishing the relative toxicity. The DEP assumes a receiving water hardness of 20 mg/L unless different site specific information is available. Similarly, default values for pH, temperature and salinity are used to determine ammonia toxicity, and pH for pentachlorophenol.

EPA has a list of 124 "priority pollutants" that it specifically lists as having known toxic effects. See 40 CFR 122, Appendix D. In addition, any other compounds that may have toxic effects should be identified in a specific effluent and evaluated. Chlorine, aluminum and ammonia are common examples of compounds not listed by EPA priority pollutants although they have toxic effects. The list of priority pollutants is broken down into five subgroups: acid organic compounds (11), volatile organic compounds (28), based neutral organic compounds (46), pesticides (25) and metals (14). Each metal is analyzed separately while the organic compounds are done through a single analysis for each of the four respective groups. Several of the metals are also included in the chemical testing done as part of WET testing.

In conducting evaluations of priority pollutant test results, the receiving water background concentration for the particular compound should be included in calculations for exceedences or reasonable potential. However, the DEP has historically not had sufficient information to accurately characterize background concentrations and has not included them its calculations. The Department is considering methods to include background concentrations in future calculations.

EPA approved test methods must be used for priority pollutant analyses. The Department has published a list of "Reporting Limits" that specify the levels of sensitivity to be attained for each priority pollutant. When the concentration in an effluent sample is below a laboratory's reporting limits, the test result is reported as "less than" (<) or "not detected" at that level. The ability to quantify each compound differs with the test method used and the individual laboratory.

Maine Department of Environmental Protection

Interference caused by substances in an effluent sample may also affect the ability of a laboratory to quantify priority pollutants, although this has not been cited as an issue very often.

Overview of results. Through late May 2001, DEP's toxicity database contained approximately 108,200 individual priority pollutant test results. The breakdown of these results by pollutant group is shown in Table I.

Table I. Distribution of priority pollutant tests - all data

Pollutant Group	Number of test results
Volatile organics	22,700
Base neutral organics	37,700
Acid organics	9,000
Pesticides	20,600
Metals	18,200
Total	108,200

These data represent more than 800 full priority pollutant scans. The number of metals is proportionally higher since metal tests are also part of the WET testing requirements. Of the total number of tests, 26,900 were conducted prior to May 1, 1996, and are now more than five years old. Generally, the Department bases its regulatory decisions on the most recent five years of information, the normal renewal cycle for a waste discharge permit.

For the organic compounds, more than 99% of the tests were reported as no detectable concentration found. Table II presents the number of tests recorded and the distribution of detectable concentrations.

Table II. Detectable concentrations of organic compounds - all data through late May 2001

Pollutant Group	Total tests	Detectable concentrations	Percent of total	Number of compounds	Number of facilities
Volatile organics	22,700	452	1.99%	22	78
Base neutral organics	37,700	304	0.81%	18	76
Acid organics	9,000	61	0.68	11	26
Pesticides	20,600	29	0.13%	14	17
Totals	90,000	844	0.94%	65	---

With the exception of the pesticide group, the occurrence of detectable concentrations of organics is predominated by a relatively few number of compounds. For example, various phthalate compounds make up most of the base neutral detections and chloroform and toluene are responsible for more than half of the volatile detections. Some facilities reported more detectable concentrations than others, with about 45% of the detections at 17 facilities. There are no obvious factors for either of these trends. However, chlorinated compounds, such as chloroform, may be formed as a result of chlorine used for effluent disinfection or in industrial processes. Pthalates are common components of plastics. The facilities having higher numbers

Maine Department of Environmental Protection

of detectable concentrations include both municipal and industrial sources. These include five industrial facilities and four municipal facilities with significant industrial contributions. Another factor possibly contributing to the incidence of detectable concentrations, although not explored, may be variations in results from various commercial laboratories conducting priority pollutant testing. False positives due to interference by related compounds also may be possible. Finally, the occurrence of detectable concentrations must be considered in conjunction with reporting limits issues discussed below.

About 18,200 metal test results are in DEP toxicity database, including those done for WET testing and as part of priority pollutant scans. This does not include metals reported on discharge monitoring, since those are stored in another data management system. Of the total number, some 10,800 were reported as "less than" values and 7,400 represent detectable concentrations. Table III provides a summary of the metal results, showing the numbers of tests for each metal and the less than and detectable values for each.

Table III. Distribution of metals tests - all data through late May 2001

Metal	Total Tests	Report <, above RL		Report <, met RL		Total <	Detectable value	
		number	% total	number	% total	number	number	% total
Antimony	838	123	14.7%	641	76.5%	764	74	8.8%
Arsenic	900	54	6.0%	631	70.1%	685	215	23.9%
Beryllium	834	155	18.6%	656	78.7%	811	23	2.8%
Cadmium	1648	314	19.1%	1056	64.1%	1370	278	16.9%
Chromium	1661	139	8.4%	1063	64.0%	1202	459	27.6%
Copper	1874	183	9.8%	55	2.9%	238	1636	87.3%
Cyanide	864	174	20.1%	583	67.5%	757	107	12.4%
Lead	1766	254	14.4%	828	46.9%	1082	684	38.7%
Mercury	1796	532	29.6%	17	0.9%	549	1247	69.4%
Nickel	1652	357	21.6%	562	34.0%	919	733	44.4%
Selenium	843	83	9.8%	705	83.6%	788	55	6.5%
Silver	910	192	21.1%	529	58.1%	721	189	20.8%
Thallium	840	200	23.8%	588	70.0%	788	52	6.2%
Zinc	1780	106	6.0%	36	2.0%	142	1638	92.0%
Totals	18206	2866	15.7%	7950	43.7%	10816	7390	40.6%

Notes

"<" means the result was reported as "less than" at a level specified by the laboratory

"RL" is the DEP specified Reporting Limit

This table separates less than values between those that met DEP reporting limits and those that were reported as less than a concentration above the established reporting limit. It must be noted that mercury is included in the table as it is a priority pollutant. However, much of the older data is based on test method EPA 245.1. In recent years, DEP has required the use of EPA method 1631 and the evaluation of reporting limits uses the lower values for this method. Accordingly, many of the apparent failures to meet reporting limits are due to comparison of older tests to the

new standard and thus should not be given any significance. Approximately 1,150 mercury tests in the database have been done using EPA 1631 and of those less than 20 have been reported as less than values. As discussed below, the conformance with metals reporting limits has improved substantially in recent years.

Review of reporting limits. As noted, the DEP has specified reporting limits for the various toxic pollutants. These were originally published in 1994 and revised in July 1996. Prior to 1994, there were no specific reporting limits published by the DEP. All evaluations of data in DEP's database uses current reporting limits. Thus, older tests may now be identified as not meeting reporting limits, although they may have at the time they were conducted. Prior to revision of reporting limits in July 1996, a significant number of tests failed to comply with reporting limits. With the revision of the limits, DEP's reemphasized their importance. Allowing time for the revised reporting limits to distributed and implemented, January 1997 can be considered an informal breakpoint for evaluation of compliance with the revised reporting limits. In March 2001, the test results in DEP database were queried on the basis of compliance with reporting limits, separating out those results before and after January 1, 1997, comparing all results to the most current limits. The results of this effort are presented in Table IV, and are arranged by organic chemicals and metals for tests done before and after January 1, 1997.

Table IV. Incidents of high reporting limits

	Total tests	High reporting limit	% High reporting limit
Organic Compounds			
Prior to 1/1/97	31,971	12,936	40.5%
After 1/1/97	55,670	2,131	3.8%
Metals			
Prior to 1/1/97	6,555	1,987	30.3%
After 1/1/97	11,241	570	5.1%

This information includes all data and in some cases tests have been repeated, with those results added without the previous tests being removed from the database. For the metals, this table excludes mercury tests. To examine trends in reporting limits performance, Table V tracks the numbers of high reporting limits by year from 1997 through 2000. The distribution of high limits for metals indicates that some of the less common metals such as antimony, arsenic, beryllium, thallium, silver and selenium have had fewer issues. Other metals, notably cadmium, lead and nickel have had the most issues. Copper, cyanide, chromium and zinc fall in the middle. Finally, it is important to note that not all failures to attain reporting limits present a serious regulatory problem by creating high degrees of uncertainty about the impact of unquantified concentrations of pollutants. In some instances a result may be over the reporting limits by a relatively small amount while others have been far above the reporting limit. The applicable water quality criteria and dilution factor for an individual discharge source must be included in an assessment of the potential impact of a given pollutant at the level actually reported. During the year of 2000, of approximately 122 full priority pollutant logged, 85 did not have any individual tests with high reporting limits. Another 20 scans had three or fewer compounds over the limit and only three had over 20 problems.

Table V. Distribution of high reporting limits by year

	Total tests	High reporting limit	% High reporting limit
Organic compounds			
1997	13,325	923	6.9%
1998	15,295	526	3.4%
1999	13,385	381	2.8%
2000	13,971	299	2.1%
Metals			
1997	2,669	229	8.6%
1998	2,879	167	5.8%
1999	2,854	80	2.8%
2000	2,769	93	3.6%

Review of Exceedences. An exceedence occurs when the effluent concentration of a pollutant is greater than a level that will assure the ambient water quality criteria in the receiving water are maintained under critical low flow conditions. This level is site specific and can be determined for each pollutant by multiplying the water quality criteria by the corresponding dilution factor for the individual facility. Three different standards may be applied to discharges under various circumstances. Standards to protect aquatic organisms are applied for both acute and chronic conditions. Alternately, the $\frac{1}{4}$ acute is used for fresh water discharges that do not receive good initial mixing. Aquatic life criteria are generally different for marine and fresh water environments. Human health criteria are applied using the single harmonic mean flow and use the organisms only criteria in marine situations but include the water and organisms criteria for fresh water. Not all pollutants have water quality criteria for all conditions. For example, many organic compounds have criteria only for human health. These various factors combine to provide a matrix of opportunities for exceedences to occur at different facilities for the individual pollutants under different flow conditions. Because of the potential for overlap of criteria, one test may result in two or more exceedences.

While the Department's toxicity program implementation protocols provide for evaluation of exceedences on a mass (pounds) basis, the evaluations of exceedences presented here are based on analysis of effluent concentrations only. In most case, this leads to a conservative approach that identifies more tests as being exceedences than would be the case had a mass based analysis been used. This is because evaluations using only concentration assume the facility is discharging at it's full design flow. Typically, facilities actually discharge at flows below their design, resulting in fewer pounds of pollutants being discharged than would be calculated assuming the full flow. In recent years, the Department has asked that facilities report their actual flows along with effluent concentrations of priority pollutants. In doing formal compliance evaluations for individual facilities, the DEP does use actual flow and quantities discharged. However, many of the test results in the database do not have actual flows available. Accordingly, to provide a consistent analysis of all test results, the evaluations here are done using the reported concentrations and the permitted flow for each facility. This method may have resulted in identifying some tests as exceedences when they were not. Consequently, the information here should be viewed as being relative and for comparative purposes only.

Maine Department of Environmental Protection

The evaluations here include all the raw data in DEP's database, and a single high test can result in exceedence of more than one criteria. Thus, the number of days when discharges exceeded water quality criteria would be less than the total number of exceedences listed. Further, since all of the test results in DEP database have been included, there may be instances where a facility reported to DEP repeated or duplicate test results and identification of such tests may remove or mitigate exceedences. Finally, data problems such as decimal errors or laboratory errors may account for either false or missed exceedences.

Table VI provides an overview of the priority pollutant exceedences, broken down by the various criteria: acute aquatic life, chronic aquatic life or human health. The table also separates out those instances where a pollutant or facility recorded only a single exceedence. For example, selenium has in all the results in DEP's database had only one test at one facility that was determined to have exceeded water quality criteria. The table further breaks out the exceedences by all test data on file and those tests done since June 1, 1996 to provide focus on the most recent five years.

Table VI. Distribution of priority pollutant exceedences by criteria

Criteria	All exceedences			Had only one exceedence	
	Number of occurrences	Number of pollutants	Number of facilities	Number of pollutants	Number of facilities
¼ Acute					
All data	105	6	14	0	4
Since 6/1/96	58	5	10	1	2
Acute aquatic life					
All data	243	7	35	2	13
Since 6/1/96	196	6	29	2	11
Chronic aquatic life					
All data	321	13	39	2	12
Since 6/1/96	216	10	34	3	12
Human health					
All data	56	13	35	9	23
Since 6/1/96	38	10	29	3	21

Since either the ¼ acute or the acute criteria, but not both, may apply to individual facilities in fresh water, the total number acute exceedences is the sum of the two criteria. The occurrence of exceedences is limited to a small number of pollutants, while the number of facilities involved is relatively greater. The numbers of pollutants and facilities having only a single exceedence is small, indicating that most exceedences are with the same pollutants and locations.

Maine Department of Environmental Protection

In Table VII, the distribution of exceedences by pollutant or group is presented. Again, the data are broken down by date - all tests and tests after June 1, 1996 - and the exceedences are shown by criteria.

Table VII. Distribution of exceedences by pollutant

Pollutants	¼ Acute		Acute		Chronic		Human Health	
	All data	Since 6/1/96	All data	Since 6/1/96	All data	Since 6/1/96	All data	Since 6/1/96
Metals								
Aluminum	9	6	1	1	47	27		
Antimony					4	3	1	
Arsenic							35	26
Cadmium	5	1	1	1	2	1		
Chromium					3			
Copper	56	29	197	159	133	102		
Cyanide			9	8	5	5		
Lead	1				43	26		
Manganese							1	1
Nickel					2	2		
Selenium					1			
Silver	11	5	18	16				
Zinc	23	17	17	14	5	3		
Ammonia					73	46		
All base neutral							10	6
All pesticides					3	1	9	5
Totals	105	58	243	194	321	216	56	38

Nearly all of the exceedences identified have been with metals or ammonia. A total of only 24 exceedences have been recorded for organic compounds. Among the metals, arsenic was a problem for only human health criteria while the exceedences with other metals were largely confined to aquatic criteria. Copper had approximately half of all the exceedences, with the greater amount of those involving the acute criteria. Other metals with relatively more frequent exceedences include aluminum, lead, silver and zinc. The distribution of exceedences between acute and chronic criteria for all metals is a function of the numeric water quality criteria and the spread between values. For instance, the lead criteria for acute are relatively very high in comparison to the chronic value, 10.52 ug/L vs. 0.41 ug/L respectively for fresh water, and all exceedences have been for the chronic criteria. Other criteria, such as copper have values that are much closer together and the combination of numeric criteria and individual dilution factor determine which standard would be exceeded.

Maine Department of Environmental Protection

The distribution of exceedences by facility dilution factor is contained in Table VIII. In this comparison, four separate facility dilution factors are used as appropriate to match the respective criteria for that individual facility.

Table VIII. Distribution of exceedences by facility dilution factor - all data

Dilution Factor	$\frac{1}{4}$ Acute		Acute		Chronic		Human Health	
	Exceedences	Facilities	Exceedences	Facilities	Exceedences	Facilities	Exceedences	Facilities
1:1			26	2				
<5:1	67	5	158	10	160	7		
5 - 10:1	28	5	43	11	59	5	5	3
11 - 15:1:1	6	1	1	1	34	6		
16: - 20:1	1	1	3	3	40	9	4	1
21 - 30:1			7	4	9	3	7	2
31 - 40:1	2	1	4	3	11	3	13	6
41 - 50:1			1	1	2	2	5	4
51 - 100:1					3	2	6	6
101 - 200:1					2	1	5	5
201 - 300:1							7	3
>300:1	1	1			1	1	4	3
Totals	105	14	243	35	321	39	56	33

Those facilities with the lower dilution factors experience the majority of the exceedences. Over 90% of all aquatic criteria exceedences occurred at dilution factors under 20 to 1. A few facilities with low dilutions have most of the exceedences, often multiple occurrences with the same pollutant over time. The human health criteria are generally at lower concentrations and consequently the observed exceedences were at higher dilution factors than for other criteria with 71% below a dilution of 100:1. The human health exceedences are more sporadic with a relatively larger number of facilities having more isolated occurrences.

Finally, the review of exceedences here is limited to detected concentrations at or above DEP reporting limits. Many pollutants have reporting limits that are higher than the established water quality criteria for that compound. In these cases, it is possible that a discharge could contain concentrations of a pollutant below the reporting limit, but still high enough to cause an exceedence of the water quality criteria. A full evaluation of this circumstance would need to be done for each pollutant and individual facility, and taking into consideration the dilution factors involved. Conversely, pollutants are sometimes found in detectable concentrations below DEP reporting limit. In these situations, an exceedence is not recorded even if one could be calculated.